PB-239 593

SWAN LAKE, COLUMBIA COUNTY, WISCONSIN

Pacific Northwest Environmental Research Laboratory

Prepared for:

National Environmental Research Center
Wisconsin Department of Natural Resources
Wisconsin National Guard

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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REPORT
ON
SWAN LAKE
COLUMBIA COUNTY
WISCONSIN

EPA REGION V

WORKING PAPER No. 50

WITH THE COOPERATION OF THE

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

AND THE

WISCONSIN NATIONAL GUARD

OCTOBER, 1974

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Wisconsin Department of Natural Resources for professional involvement and to the Wisconsin National Guard for conduct of the tributary sampling phase of the Survey.

Francis H. Schraufnagel, Acting Assistant Director, and Joseph R. Ball of the Bureau of Water Quality, and Donald R. Winter, Lake Rehabilitation Program, provided invaluable lake documentation and counsel during the Survey. Central Office and District Office personnel of the Department of Natural Resources reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper series.

Major General James J. Lison, Jr., the Adjutant General of Wisconsin, and Project Officer CW-4 Donald D. Erickson, who directed the volunteer efforts of the Wisconsin National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

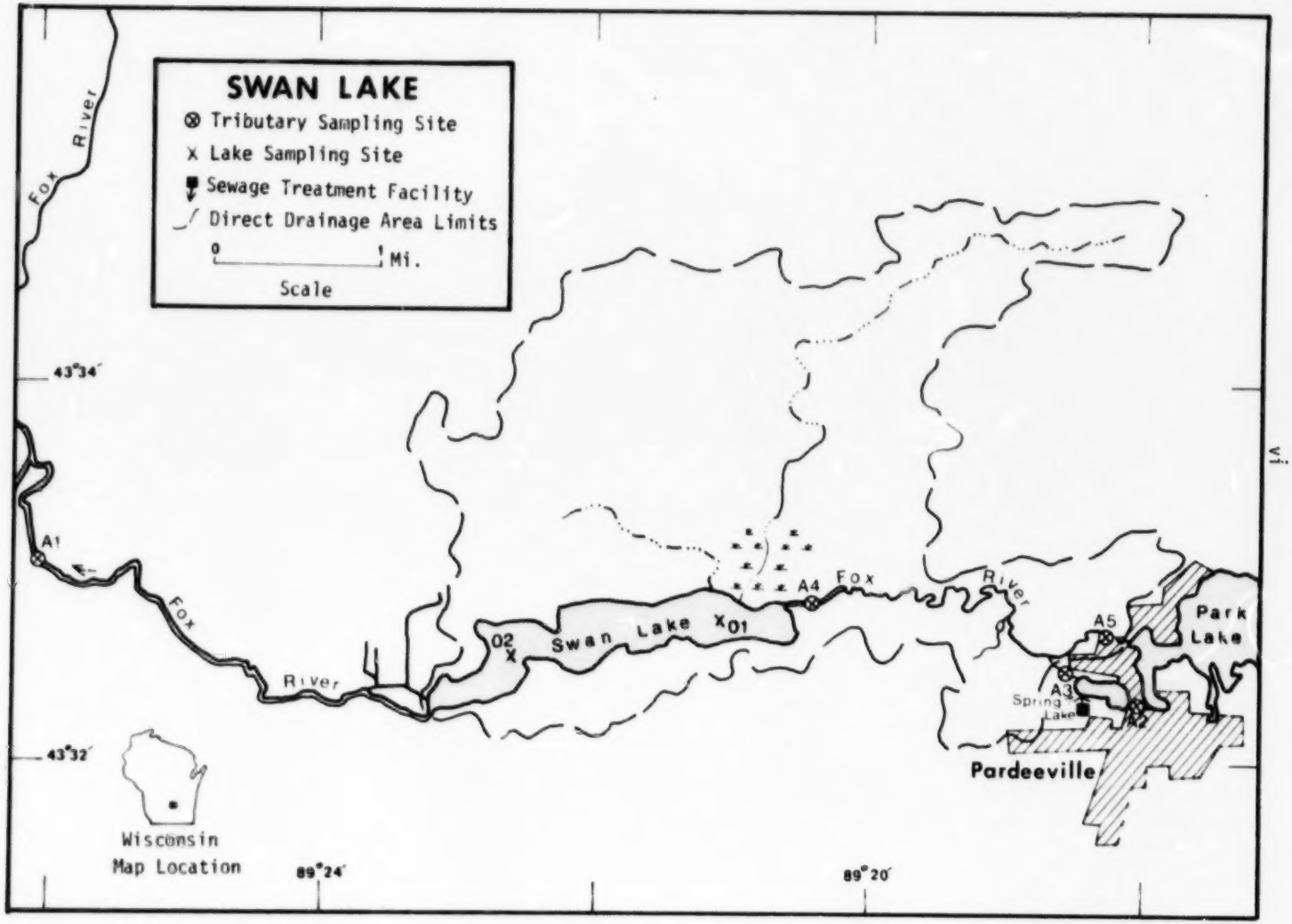
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF WISCONSIN

LAKE NAME	COUNTY
Altoona	Eau Claire
Beaver Dam	Barron
Beaver Dam	Dodge
Big Eau Pleine	Marathon
Browns	Racine
Butte des Morts	Winnebago
Butternut	Price, Ashland
Castle Rock Flowage	Juneau
Como	Walworth
Crystal	Vilas
Delavan	Walworth
Eau Claire	Eau Claire
Elk	Price
Geneva	Walworth
Grand	Green Lake
Green	Green Lake
Kegonsa	Dane
Koshkonong	Jefferson, Rock, Dane
Lac La Belle	Waukesha
Long	Price
Middle	Walworth
Nagawicka	Waukesha
Oconomowoc	Waukesha
Okauchee	Waukesha
Petenwell Flowage	Juneau
Pewaukee	Waukesha
Pigeon	Waupaca
Pine	Waukesha
Poygan	Winnebago, Waushara
Rock	Jefferson
Rome Pond	Jefferson, Waukesha
Round	Waupaca
Shawano	Shawano

LAKE NAME	COUNTY
Sinnissippi	Dodge
Swan	Columbia
Tainter	Dunn
Tichigan	Racine
Townline	Oneida
Trout	Vilas
Wapogassett	Polk
Wausau	Marathon
Willow	Oneida
Winnebago	Winnebago, Fond Du Lac, Calumet
Wisconsin	Columbia
Wissota	Chippewa
Yellow	Burnett


SWAN LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Direct Drainage Area Limits
0
1 Mi.
Scale
Fox River
43°34'
43°32'
A1
A4
A5
A3
Spring Lake
Park Lake
Swan Lake
02
01
Pardeeville
Wisconsin
Map Location
89°24'
89°20'

SWAN LAKE

STORET NO. 5545

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate Swan Lake is eutrophic.

B. Rate-Limiting Nutrient:

Results of the algal assay indicate Swan Lake was nitrogen limited at the time the sample was collected. However, lake data indicate the lake may be phosphorus limited at times.

C. Nutrient Controllability:

During the Survey sampling year, there appeared to be a significant phosphorus loss from Swan Lake. This would not be expected in a lake with a retention time of almost one-half year, and this leads to the assumption that the phosphorus loading data do not reflect the actual inputs to the lake and/or the outputs.

The site selected as the inlet sampling station (A-4; see map, page vi) was inaccessible because of the marshy terrain. Had this station been sampled, about two more stream miles of non-point contributions would have been included in the inputs. Also because of inaccessibility due to marshes, it was necessary to sample the Fox River outlet (A-1) at a point about three stream miles downstream from the actual outlet; and, thus, about three stream miles of non-point contributions were added to the apparent outputs. It is probable that had the actual inlet and outlet been sampled, the

resulting increase in input and decrease in output would have resulted in a phosphorus accumulation in Swan Lake.

In any case, it does not appear likely that reduction of phosphorus in the effluent of the Pardeeville wastewater treatment plant would result in improvement of the trophic condition of Swan Lake commensurate with the cost of the treatment. It is calculated that even a 100% removal of phosphorus at that source would still leave a loading rate of 1.74 $g/m^2/yr$, or more than twice that proposed by Vollenweider (in press) as "dangerous"; i.e., a eutrophic rate (see page 14).

II. INTRODUCTION

Swan Lake is located in a glaciated area of Wisconsin, and the drainage is in glacial drift. The economy of the area is based on agriculture, particularly the growing of canning crops.

The lake is used for boating and fishing. Game fish present include northern pike, walleyes, largemouth bass, and panfish. Public access is provided, but there are no resorts or boat liveries at the lake.

III. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry:

1. Surface area: 406 acres.
2. Mean depth: 31.8 feet.
3. Maximum depth: 82 feet.
4. Volume: 12,897 acre/feet.
5. Mean hydraulic retention time: 178 days.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area*	Mean flow*
Fox River	58.6 mi^2	31.8 cfs
Minor tributaries & immediate drainage -	8.4 mi^2	4.8 cfs
Totals	67.0 mi^2	36.6 cfs

2. Outlet -

Fox River	67.6 mi^2**	36.6 cfs

C. Precipitation†:

1. Year of sampling: 42.7 inches.
2. Mean annual: 30.7 inches.

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* Drainage areas are accurate within ±0.5%; mean daily flows are accurate within ±40%; mean monthly flows are accurate within ±35%; and normalized mean monthly flows are accurate within ±35%.

** Includes area of lake.

† See Working Paper No. 1, "Survey Methods".

IV. LAKE WATER QUALITY SUMMARY

Swan Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the lake and from a number of depths at each station (see map, page vi). During each visit, a single depth-integrated (15 feet to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each station for chlorophyll a analysis. The maximum depths sampled were 40 feet at station 1 and 76 feet at station 2.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake was essentially well-mixed, are summarized below. Note however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES (11/10/72)		
Temperature (Cent.)	7.0	7.3	7.3	7.4
Dissolved oxygen (mg/l)	4.1	6.0	5.3	8.7
Conductivity (μmhos)	410	415	415	420
pH (units)	7.5	7.6	7.6	7.8
Alkalinity (mg/l)	182	195	195	214
Total P (mg/l)	0.123	0.168	0.170	0.235
Dissolved P (mg/l)	0.108	0.151	0.156	0.206
NO_2 + NO_3 (mg/l)	0.090	0.107	0.095	0.190
Ammonia (mg/l)	0.600	0.828	0.860	1.120
		ALL VALUES		
Secchi disc (inches)	24	80	93	108

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/22/72	1. Fragilaria	1,687
	2. Chroococcus	361
	3. Dinobryon	346
	4. Gloeocapsa	166
	5. Microcystis	136
	Other genera	406
	Total	3,102
08/20/72	1. Merismopedia	2,043
	2. Anabaena	1,953
	3. Dinobryon	452
	4. Fragilaria	398
	5. Melosira	217
	Other genera	868
	Total	5,931
11/10/72	1. Anabaena	268
	2. Lyngbya	253
	3. Melosira	61
	4. Flagellates	36
	5. Stephanodiscus	29
	Other genera	94
	Total	741

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/22/72	01	7.3
	02	2.3
08/20/72	01	7.0
	02	10.6
11/10/72	01	10.7
	02	11.2

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.138	0.740	17.2
0.006 P	0.144	0.740	19.0
0.012 P	0.150	0.740	20.8
0.024 P	0.162	0.740	18.0
0.060 P	0.198	0.740	17.4
0.060 P + 10.0 N	0.198	10.740	91.1
10.0 N	0.138	10.740	70.1

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that Swan Lake had a high level of potential productivity at the time the sample was collected. Also, the lack of significant change in yields with increased levels of orthophosphorus, until nitrogen was also added, shows that

the system was nitrgoen limited when sampled. Note that the addition of only nitrogen resulted in a yield far greater than the control yield.

The lake data indicate that Swan Lake may be phosphorus limited at times. During the August and November sampling periods, the nitrogen to phosphorus ratios obtained were about 6 to 1 (nitrogen limitation would be expected). However, during the June sampling the N/P ratio was about 16/1; i.e., phosphorus limitation would be expected at that time.

A number of other Survey lakes have exhibited a similar temporal shift in limiting nutrient, including Shagawa Lake in Minnesota which has been intensively studied by personnel of the National Eutrophication Branch of EPA.

D. Trophic Condition:

Survey data indicate that Swan Lake is eutrophic. Algal blooms are said to be frequent, and rooted aquatic vegetation occurs in about 25% of the littoral zone.

Of the 46 Wisconsin lakes included in the Survey, 37 had less mean total phosphorus, 40 had less mean inorganic nitrogen, and 18 had less mean chlorophyll a. Oxygen depression with depth was noted during the June sampling, and oxygen depletion occurred at about 30 feet in August.

V. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Wisconsin National Guard collected a monthly near-surface grab sample from tributary sites A-1, A-2, and A-5 (see map, page vi), except for the high runoff months of April and May, when two samples were collected. Sampling was begun in September, 1972, and was completed in August, 1973.

Sampling sites A-3 and A-4 shown on the map were found to be inaccessible because of swampy terrain, and no samples were collected from those sites. Because of this, the inlet nutrient loads had to be calculated indirectly by using the combined mean nutrient concentrations in the system at stations A-2 and A-5 and the mean flow at station A-4. The nutrient loads shown for the Fox River inlet in the following loading tables do not include the loads attributed to the Pardeeville wastewater treatment plant.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Wisconsin District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were calculated using the combined mean concentrations in the system at stations A-2 and A-5 and ZZ flows.

The Village of Pardeeville declined participation in the Survey, and nutrient loads attributed to that source are estimates based on the 1970 census and annual per capita contributions of 2.5 lbs of phosphosus and 7.5 lbs of nitrogen.

A. Waste Sources:

1. Known municipal -

Name	Pop. Served	Treatment	Mean Flow (mgd)	Receiving Water
Pardee-ville	1,507	Trickling filter	0.150*	Fox River

2. Known industrial -

Name	Product	Treatment	Mean Flow (mgd)	Receiving Water
Pardee-ville Canning Co.	peas & corn	Seepage lagoon	?	Park Lake (?)

* Estimated at 100 gal/capita/day.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Fox River	5,390	53.5
b. Minor tributaries & immediate drainage (non-point load) -	810	8.1
c. Known municipal STP's -		
Pardeeville	3,770	37.4
d. Septic tanks* -	40	0.4
e. Known industrial -		
Pardeeville Canning Co.	?	-
f. Direct precipitation** -	60	0.6
Total	10,070	100.0

2. Outputs -

Lake outlet - Fox River 11,900

3. Net annual P loss - 1,830 pounds

* Estimated 60 dwellings on lakeshore; see Working Paper No. 1.
** Estimated; see Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/ yr	% of total
a. Tributaries (non-point load) -		
Fox River	109,840	76.8
b. Minor tributaries & immediate drainage (non-point load) -	16,540	11.6
c. Known municipal STP's -		
Pardeeville	11,300	7.9
d. Septic tanks* -	1,410	1.0
e. Known industrial -		
Pardeeville Canning Co.	?	-
f. Direct precipitation** -	3,910	2.7
Total	143,000	100.0

2. Outputs -

Lake outlet - Fox River 126,740

3. Net annual N accumulation - 16,260 pounds

* Estimated 60 dwellings on lakeshore; see Working Paper No. 1.
** Estimated; see Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	lbs P/mi^2/yr	lbs N/mi^2/yr
Fox River	92	1,874

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

	Total Phosphorus		Total Nitrogen	
Units	Total	Accumulated	Total	Accumulated
lbs/acre/yr	24.8	loss*	352.2	40.0
grams/m^2/yr	2.78	-	39.5	4.5

Vollenweider loading rates for phosphorus (g/m^2/yr) based on mean depth and mean hydraulic retention time of Swan Lake:

"Dangerous" (eutrophic rate)	0.86
"Permissible" (oligotrophic rate)	0.43

* See "Nutrient Controllability", page 1.

VI. LITERATURE REVIEWED

Anonymous, 1972. Wisconsin lakes. Publ. 218-72, Dept. Natural Resources, Madison.

Schraufnagel, F. H., L. A. Montie, J. R. McKersie, and Donald Winter, 1967. Report on an investigation of the pollution in the Upper Fox River basin made during 1966 and early 1967. Dept. of Natural Resources, Madison.

Vollenweider, Richard A., (in press). Input-output models. Schweiz A. Hydrol.

VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR WISCONSIN 9/30/74

LAKE CODE 5545 SWAN LAKE

TOTAL DRAINAGE AREA OF LAKE 67.60

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
5545A1	67.60	17.30	29.50	65.00	68.00	42.70	59.90	30.50	24.40	30.50	26.40	24.40	21.30	36.62
5545A4	58.60	19.00	25.00	58.00	58.00	34.00	51.00	26.00	19.00	24.00	24.00	24.00	20.00	31.81
5545ZZ	9.00	2.30	3.90	8.50	8.90	5.60	7.90	3.90	3.20	4.00	3.50	3.10	2.80	4.79

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 67.60 TOTAL FLOW IN = 439.60
SUM OF SUB-DRAINAGE AREAS = 67.60 TOTAL FLOW OUT = 439.90

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
5545A1	9	72	66.00	24	68.00				
	10	72	80.00	14	60.00				
	11	72	69.00						
	12	72	45.00	10	42.00				
	1	73	110.00						
	2	73	78.00	11	65.00				
	3	73	240.00	14	320.00				
	4	73	150.00	7	130.00	20	170.00		
	5	73	170.00	3	210.00	17	140.00		
	6	73	75.00	24	64.00				
	7	73	33.00	18	28.00				
	8	73	29.00	16	27.00				
5545A4	9	72	50.00	24	51.00				
	10	72	60.00	14	46.00				
	11	72	52.00						
	12	72	34.00	10	32.00				
	1	73	85.00						
	2	73	50.00	11	49.00				
	3	73	210.00	14	280.00				
	4	73	130.00	7	110.00	20	150.00		
	5	73	150.00	3	190.00	17	120.00		
	6	73	58.00	24	49.00				
	7	73	25.00	18	22.00				
	8	73	23.00	16	21.00				
5545ZZ	9	72	1.40	24	1.40				
	10	72	1.70	14	1.30				
	11	72	1.40						
	12	72	1.00	10	0.90				
	1	73	2.50						
	2	73	1.80	11	1.50				
	3	73	34.00	14	48.00				
	4	73	20.00	7	17.00	20	21.00		
	5	73	23.00	3	28.00	17	18.00		
	6	73	1.80	24	1.50				
	7	73	0.80	18	0.70				
	8	73	0.70	16	0.60				

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/09/30

554501
43 32 48.0 089 21 06.0
SWAN LAKE
55 WISCONSIN

11EPALES
3

2111202
0018 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/22	17 30	0000	21.6	11.6	96	310	8.80	180	0.100	0.070	0.072	0.020
	17 30	0015	16.8	5.4		325	8.10	186	0.280	0.240	0.032	0.010
72/08/20	16 15	0000				319	8.75	155	0.060	0.080	0.090	0.014
	16 15	0004	26.1	10.4		320	8.75	158	0.060	0.070	0.038	0.012
	16 15	0015	20.7	0.7		360	8.68	169	0.050	0.100	0.021	0.009
	16 15	0020	18.9	0.6		360	7.65	171	0.050	0.150	0.030	0.013
	16 15	0030	8.0	0.3		360	7.70	162	0.060	0.080	0.022	0.012
	16 15	0040	6.4	0.0		410	7.25	188	0.050	1.680	0.350	0.265
72/11/10	08 40	0000				420	7.80	214	0.110	0.720	0.149	0.132
	08 40	0004	7.3	7.2		410	7.80	198	0.110	0.770	0.141	0.134
	08 40	0015	7.3	7.0		410	7.80	198	0.120	0.730	0.148	0.135
	08 40	0022	7.2	7.3		420	7.60	198	0.110	0.740	0.140	0.131
	08 40	0036	7.0	8.7		420	7.60	200	0.190	0.600	0.123	0.108

DATE FROM TO	TIME OF DAY	DEPTH FEET	32211 CHLRPHYL A UG/L
72/06/22	17 30	0000	7.3J
72/08/20	16 15	0000	7.0J
72/11/10	08 40	0000	10.7J

J* VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/09/30

554502
43 32 36.0 089 22 36.0
SWAN LAKE
55 WISCONSIN

11EPALES 2111202
3 0020 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/22	18 00	0000	21.6	11.3	90	310	8.80	174	0.100	0.040	0.030	0.016
	18 00	0015	19.8	9.5		310	8.70	177	0.150	0.100	0.024	0.023
72/08/20	15 40	0000			24	305	8.88	142	0.060	0.090	0.030	0.013
	15 40	0004	26.9	13.8		305	8.90	142	0.080	0.100	0.028	0.014
	15 40	0015	21.9	4.2		335	8.10	179	0.050	0.610	0.081	0.050
	15 40	0025	13.6			390	7.40	192	0.070	1.240	0.071	0.210
	15 40	0035	6.8	0.0		400	7.30	192	0.130	1.760	0.377	0.325
	15 40	0046	6.2	0.0		405	7.20	194	0.050	1.640	0.373	0.327
	15 40	0056	6.1	0.0		410	7.20	198	0.050	1.700	0.383	0.340
	15 40	0066	6.0	0.04		405	7.20	200	0.130	1.020	0.425	0.385
	15 40	0076	5.9	0.0		403	7.20	198	0.150	2.420	0.397	0.332
72/11/10	08 10	0000			108	420	7.60	188	0.100	0.860	0.176	0.156
	08 10	0004	7.4	5.3		420	7.60	188	0.090	0.860	0.166	0.156
	08 10	0015	7.3	5.3		420	7.60	186	0.090	0.860	0.175	0.156
	08 10	0022	7.4	5.2		410	7.50	182	0.090	0.870	0.184	0.158
	08 10	0030	7.4	5.2		410	7.50	192	0.090	0.890	0.179	0.162
	08 10	0040	7.3	5.1		410	7.50	202	0.090	0.920	0.199	0.177
	08 10	0051	7.3	4.1		410	7.50	192	0.090	1.120	0.235	0.206

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/22	18 00	0000	2.3J
72/08/20	15 40	0000	10.6J
72/11/10	08 10	0000	11.2J

J= VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY DATA

STORET RETRIEVAL DATE 74/10/02

S5545A1 LS5545A1
43 23 00.0 089 25 30.0
FOX RIVER
55 15 PORTAGE
O/SWAN LAKE
ON RR TREST.5 MI E PORTAGE STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/24			0.140	1.100	0.051	0.005K	0.031
72/10/14	10 00		0.240	1.200	0.290	0.034	0.066
72/11/11	08 30		0.360	1.700	0.302	0.120	0.140
72/12/10	10 00		0.360	1.890	0.399	0.095	0.126
73/01/14	13 30		0.350	1.260	0.360	0.085	0.115
73/03/14	08 30		0.760	1.400	0.290	0.060	0.144
73/04/07	12 00		0.770	1.050	0.084	0.060	0.085
73/05/03	07 15		2.080	0.600	0.054	0.073	0.150
73/05/17	12 45		0.168	1.400	0.021	0.032	0.060
73/06/24			0.039	1.150	0.220	0.210	0.280
73/07/18			0.082	1.540	0.360	0.310	0.400
73/08/16	08 00		0.056	1.400	0.294	0.250	0.315

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 74/10/02

5545A2 LS5545A2
43 32 30.0 089 18 00.0
FOX RIVER
55 15 PORTAGE
T/SWAN LAKE
ST HWY 22 BRDG ABOVE PARDEEVILLE STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/24	10	40	0.086	1.450	0.168	0.010	0.064
72/10/14	09	30	0.084	1.250	0.170	0.021	0.052
72/11/11	09	20	0.290	1.300	0.033	0.012	0.033
72/12/10	09	30	0.370	0.870	0.044	0.011	0.025
73/02/11	09	00	1.440	1.900	0.490	0.100	0.200
73/03/14	05	20	0.680	1.540	0.500	0.100	0.260
73/04/07	11	25	0.294	1.600	0.030	0.007	
73/04/20	11	55	0.210	1.090	0.031	0.005K	0.035
73/05/03	16	30	0.093	0.960	0.019	0.021	0.067
73/05/17	12	25	0.120	1.100	0.012	0.008	0.045
73/06/24			0.010K	1.150	0.036	0.084	0.145
73/07/18			0.015	1.760	0.039	0.027	0.113
73/08/16	08	25	0.014	1.600	0.044	0.032	0.125

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 74/10/02

554545 L3554545
43 32 45.0 089 18 15.0
FOX RIVER
55 15 PORTAGE
T/SWAN LAKE
HWY 22 BRDG N EDGE PARDEEVILLE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/04/24	12 00		0.605	1.200	0.121	0.046	0.060
72/10/14	09 40		0.160	1.200	0.168	0.015	0.045
72/11/11	09 00		0.320	1.100	0.024	0.010	0.033
72/12/10	09 00		0.700	0.920	0.054	0.011	0.024
73/02/11	08 50		1.600	1.800	0.520	0.105	0.143
73/03/14	05 00		0.300	1.600	0.310	0.072	0.100
73/04/07	11 30		0.310	1.470	0.018	0.005K	
73/04/20	13 45		0.190	1.100	0.031	0.005K	0.030
73/05/03	16 00		0.075	0.960	0.017	0.011	0.045
73/05/17	12 30		0.010K	1.200	0.010	0.005K	0.040
73/06/24			0.870	2.400	0.147	0.052	0.125
73/07/14			0.680	1.600	0.097	0.020	0.100
73/08/16	08 20		0.590	1.400	0.064	0.021	0.100

K VALUE KNOWN TO BE LESS THAN INDICATED